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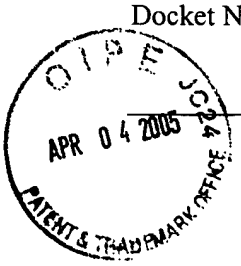
Docket No.: USFMCR.122C1

April 1, 2005
Page 1 of 1



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TRANSMITTAL LETTER

Applicant	:	Cox, et al.
App. No	:	10/676,458
Filed	:	September 30, 2003
For	:	POTTING METHOD
Examiner	:	Ortiz, A.
Art Unit	:	1732

CERTIFICATE OF MAILING

I hereby certify that this correspondence and all marked attachments are being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on

April 1, 2005
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Rose M. Thiessen, Reg. No. 40,202

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Dear Sir:

Enclosed for filing in the above-identified application are:

(X) Certified Copy of International Appl. No. PCT/AU02/00436

(X) Certified Copy of Australia Provisional Appl. No. PR 4215

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CERTIFIED COPY OF PRIORITY DOCUMENT

I, LEANNE MYNOTT, MANAGER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PR 4215 for a patent by U.S. FILTER WASTEWATER GROUP, INC. as filed on 04 April 2001.

WITNESS my hand this
Fourteenth day of December 2004

LEANNE MYNOTT
MANAGER EXAMINATION SUPPORT
AND SALES

COMMONWEALTH OF AUSTRALIA
AUSTRALIA
PATENT OFFICE

AUSTRALIA

PATENTS ACT 1990

PROVISIONAL SPECIFICATION

FOR THE INVENTION ENTITLED:-

"Potting Method"

The invention is described in the following statement:-

The present invention relates to potting methods for porous hollow fibre membranes typically used in filtration systems.

The potting materials used to support and hold arrays of porous hollow fibre membranes are usually a compromise between materials which have sufficient rigidity to provide adequate support but sufficient softness and flexibility to avoid breakage of the fibres where they enter the pot. Too rigid a material produces rapid breakage of fibres adjacent the pot while too soft a material does not have sufficient mechanical strength to adequately support the fibres. The materials are also chosen to resist breakdown as a result of exposure to various types of feed as well as cleaning fluids used to maintain the fibres.

Known systems employ single layers of epoxy, polyurethane or silicon materials, however, each suffer from the disadvantages outlined above.

The foregoing discussion of prior art is not to be construed as an admission with regard to the common general knowledge in Australia.

The present invention seeks to overcome or at least ameliorate one or more of the disadvantages of the prior art outlined above or at least provide a useful alternative.

According to one aspect, the present invention provides a method of forming a pot for an array of hollow fibre membranes including the steps of placing the ends of said fibre membranes in a mould; forming a first layer of curable resin material in a non-cured state around said fibre membrane ends,

applying a second layer of a second material to said first layer prior to full curing of said first layer, said second material layer being chemically reactive with said first layer material to form an adhesive bond therebetween; at least partially curing both layers and removing the pot formed from said mould, wherein said second material is of higher flexibility than said first layer material when each layer is fully cured.

It will be appreciated that any known method of sealing the open fibres may be used prior to the potting process described above.

Preferably, the curable resin material is an epoxy resin. The second layer of material may also be formed of epoxy resin though other suitable materials such as polyurethane resin may also be used. The use of an epoxy resin for both layers has been found to be advantageous when potting fibre membranes which typically contain hydroscopic liquids which may produce sealing problems between the fibres and the pot when polyurethane resin is used.

In one preferred form the layer of higher flexibility is produced by adding one or more flexibilising agents to the components of the material forming the first layer of lower flexibility.

Preferably, the method includes the step of the monitoring the curing process of the first layer to determine the optimal time in which to apply the second layer thereto. For preference, the step of monitoring includes monitoring the temperature changes within said first layer to determine the state of the curing process.

It is important that the second layer be applied to the first layer prior to curing of the first layer being completed so that there are sufficient active sites available for the chemical reaction required to adhere one layer to the other can take place. Proper adhesion of the two layers is required to prevent ingress of feed between the layers and growth of bacteria etc. between the layers leading to damage and breakage of fibres and consequential contamination of the filtrate. The use of this process also eliminates the need for special adhesives and primers to produce adhesion between the layers.

A necessary condition for the adhesion of the two layers is the chemical reaction between some of the components of the two different layers. For epoxy/polyurethane layers, it is desirable that one of the epoxy components is reactive with the isocyanate groups of the polyurethane (preferably amines or amides).

According to a second aspect, the present invention provides an apparatus for potting hollow fibre membranes including:

a mould for receiving the ends of said hollow fibre membranes;

means for forming a first layer of curable resin material in a non-cured state around said fibre membrane ends in said mould,

means for applying a second layer of a second material to said first layer prior to full curing of said first layer, said second material layer being chemically reactive with said first layer material to form an adhesive bond therebetween

and said second material being of higher flexibility than said first layer material when each layer is fully cured.

Preferably, the mould includes separate means for flowing said first and second layer materials into the mould. For preference, said materials are fed into a centrifuge before being flowed along a conduit or tube into the mould. Preferably, a single centrifuge may be used having separate sections to receive the respective first and second layer materials.

Although, a centrifuge is the preferred tool used in the method, it will be appreciated that other techniques such as static potting are equally applicable to the inventive method.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a simplified schematic diagram of the potting apparatus used to perform the potting method in accordance with one embodiment of the present invention; and

Figure 2 shows a cross-sectional view of one potted end of the fibres illustrating one embodiment of the invention.

Referring to Figure 1, the potting apparatus comprises a mould 5 for receiving the ends 6 of the fibres membranes 7. The mould 5 includes a cylindrical cavity 8 for receiving the fibre membranes 7. The cavity 8 has an enlarged- diameter base portion 9 for holding the prepot 10 which serves to support the fibres during the potting process. A tube or hose 11 connects one

bowl 12 of a centrifuge 13 to the base 14 of the mould cavity 8. A second tube 15 connects a second bowl 16 of the centrifuge 13 to the upper portion 17 of the mould cavity 8.

In use, the material for forming the first relatively hard layer of the pot is dispensed into bowl 12 of the centrifuge 13 and flowed along tube or hose 11 into the lower portion 14 of the mould cavity 8 to form a first layer around the fibre ends 6. Prior to full curing of this material, a second material for forming the second softer layer is dispensed into bowl 16 and flowed along tube or hose 15 into the mould cavity 8 to apply the second layer of material to the first layer. The layers chemically react to form an adhesive bond between the first and second layers. At an appropriate curing stage the potted fibres are removed from the mould 5.

In some applications, it may be possible to use a single bowl and tube to flow the materials sequentially into the mould to form the two layers.

In order to determine the optimal time during the curing of the first layer for applying the second layer, the temperature profile of the first layer material may be monitored, at least during the initial set up of the process. The temperature profile indicates the various stages of the curing process and when the second layer may be applied to ensure that sufficient free sites are available for chemical bonding between the two layers. Once the optimal time has been determined for a particular material combination further monitoring is unnecessary.

A steep rise in temperature indicates that the majority of the curing reaction is taking place. The optimal time for the addition of the second layer has been found to be within ± 5 minutes of the time of this temperature rise and preferably, ± 2 minutes.

The embodiment shown in Figure 2 illustrates a method using a potting sleeve 23 to enhance the interfacial binding between the potting layers 20, 21. The quantity of potting materials or the width of the potting sleeve 23 is selected to ensure that the interface 24 of the two layers is within the potting sleeve 23. The potting sleeve 23 is formed from material which ensures good adhesion between its inner surface and the two potting materials. Besides the selection of the potting sleeve material, roughening the inner surface of the sleeve 23 can also enhance the binding of the potting materials with the sleeve 23. Further enhancement can be achieved by forming grooves 25 in the potting sleeve 23. Due to the adhesive force between the potting materials and the potting sleeve 23, it serves to reduces any movement or detachment of the two potting layers 20, 21 at the interface 24, and therefore enhances the binding of the two potting layers 20, 21.

The potting method outlined above provides a number of advantages over the prior art including improved support of the fibres serves to reduce breakages at the fibre/pot interface. In some applications it is also possible to dispense with the usual potting sleeve as the pot formed by this method has sufficient rigidity to be self-supporting. This produces a manufacturing saving as in some cases shrinkage of the potting materials relative to the potting sleeve produces

gaps which are again undesirable in terms of leakage and bacterial growth. In such cases the pot must be discarded.

It will be appreciated that further embodiments and exemplifications of the invention are possible without departing from the spirit or scope of the invention described.

Dated this 4th day of April, 2001

U.S. FILTER WASTEWATER GROUP, INC. and
SEITZSCHENK FILTERSYSTEMS GmbH

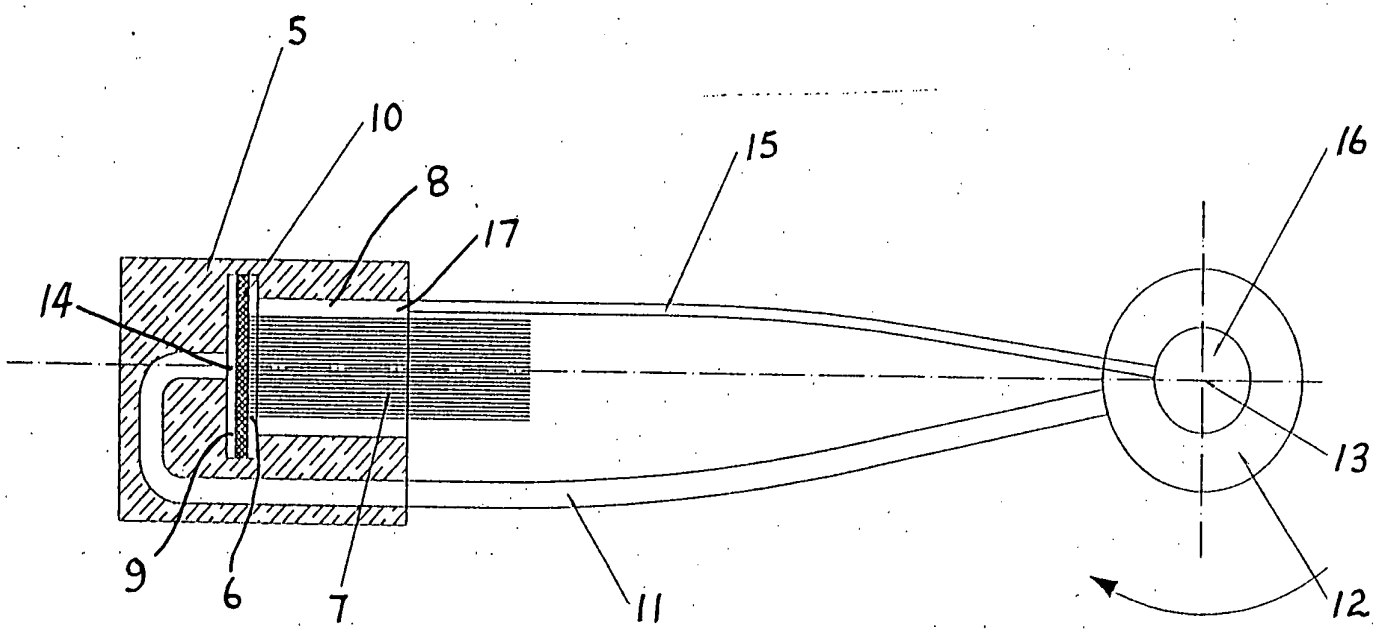

Fig. 1

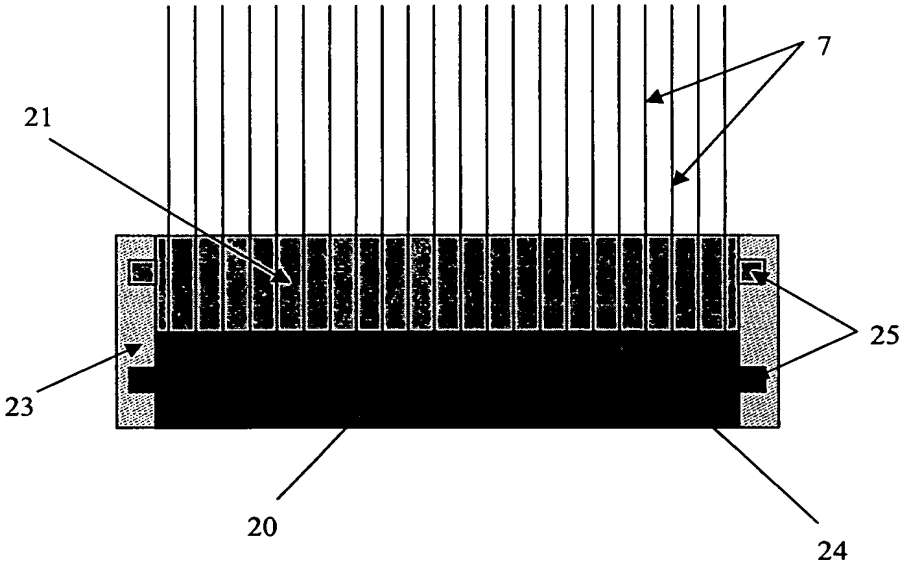

Figure 2